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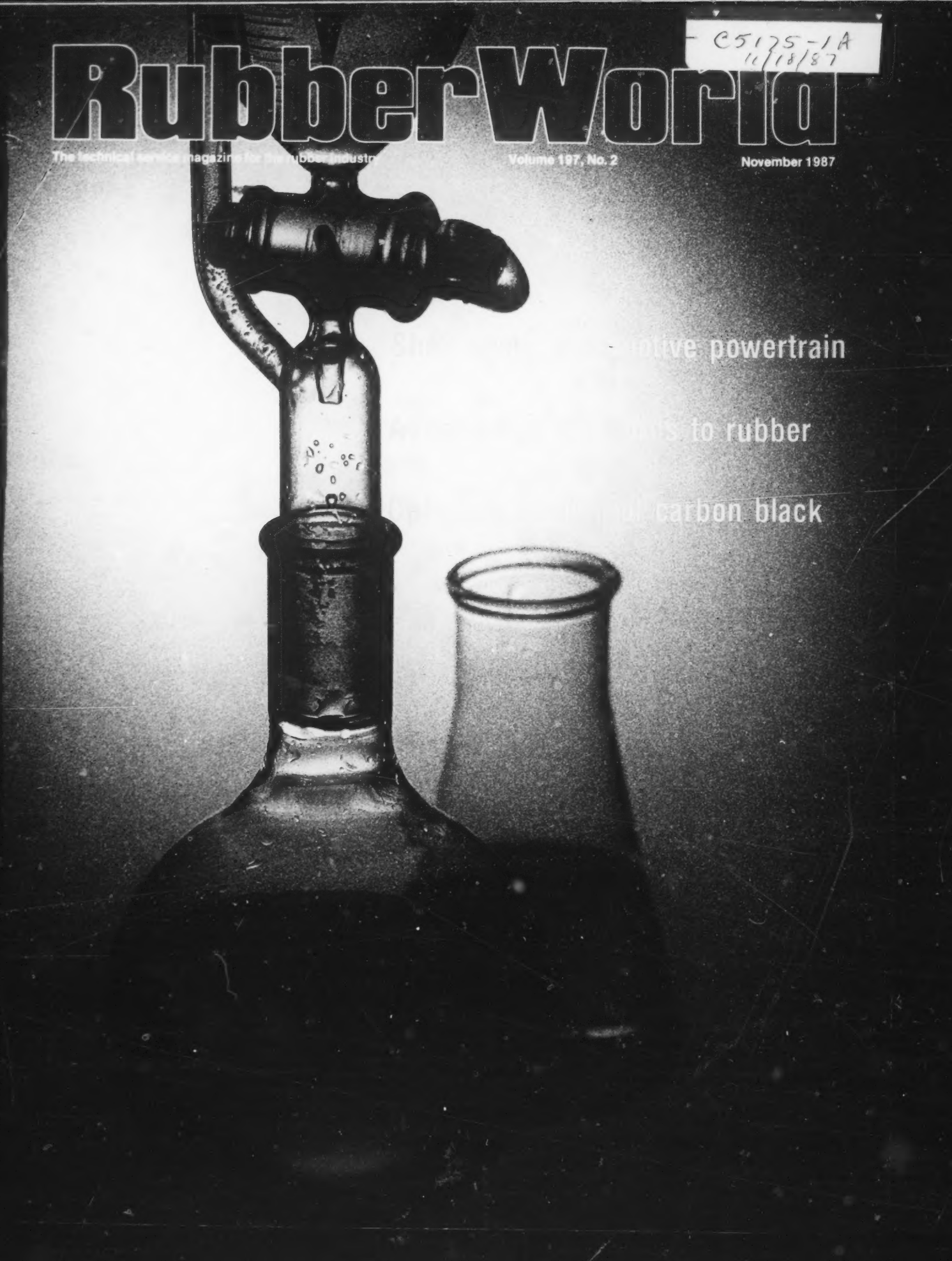

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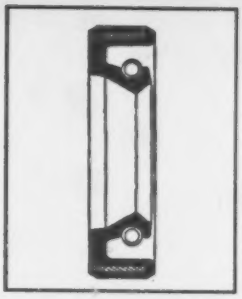

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8 Tech Service: Design basics: Stress-strain relationships
by Jon Menough, contributing technical service editor. A look at the stress-strain relationships in rubber, including hardness and tension tests, and the roles they play in design applications of rubber.

10 Urethane Forum: Polyurea RIM; novel applications and technical advances
by R.J.G. Dominguez, D.M. Rice and R.A. Grisby, Texaco Chemical. The focus of this review is to enable the reader to understand how polyurea RIM materials address the processing and property needs of the RIM industry.

15 Shaft seals: Automotive powertrain applications
by Robert Bond, CR Industries. This article reviews existing shaft seals used in the automotive powertrain, the perceived trends in the automotive industry and how the sealing industry is handling the problems of meeting these trends.

24 Adhesion of tire cords - the total picture
by Raj Iyengar, consultant. The author reviews the effects of polymer/fiber, fiber surface, cord/fabric geometry, finish, adhesive, rubber characteristics, and environmental exposure of cords on adhesion, and stresses the importance of considering the total impact of the cord/adhesive/rubber system in solving adhesion problems.

30 Optimum loading of carbon black in rubber by Monsanto oscillating disc rheometer
by Anil K. Sircar, Center for Basic and Applied Polymer Research, University of Dayton. Evaluation of different carbon blacks by the measurement of rubber properties is an accepted industrial practice. This article suggests that carbon blacks should be compared at the "optimum loading" which is different for different blacks.

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Editorial

In these days where everything is computerized, there seems to be a glut of statistical information. The shear mass of figures that bombards us daily makes it hard to discern just what has relevance. We recently received a study indicating that in the year 2000 each tire worker will produce five times more miles of tire life than in 1980. This came from Technology Futures Inc. of Austin, TX, who recently did some interesting numbers crunching that pertains to the rubber industry. *Implications of improved productivity on future jobs for tire workers* is a different type of study that was conducted to learn how manufacturing innovations (productivity) and product changes (average tire life) affect future requirements for new tires and what these changes mean for future employment in the industry. The forecast is for a gradual decline in total employment for American tire workers by the year 2000, but not due to decreases in the use of domestic made tires. FTI says that the increase in utility of each tire produced coupled with the increases in productivity for each worker will be the main causes.

Although the study is directed at ascertaining employment levels, the other information presented is interesting. Projected average speed for all vehicles in the year 2000 will be 74 mph. Had it not been for the 1973 fuel crisis and the implementation of 55 mph limits, average speed would have been 95 mph based on an average speed increase of 1.4% per year which occurred between 1945 and 1973. FTI's data shows an increase in average tire life of 1.3% per year, representing a long doubling time of 55 years. But when you factor in the increases in average speed, mileage per tire increased at a rate of 4.2% per year between 1930 and 1970. By 2000, mileage per tire at 60 mph is projected to reach nearly 60,000 miles, a doubling time of 17 years. The number of tires produced per worker per year has increased at an average rate near 4.3% per year since 1947, meaning the number of tires produced per tire production worker will double by 2000, the study says. But a more accurate view of productivity combines the average tire miles and tires produced per worker to show tire miles produced per worker, which will be at 310 million miles of tire life in 2000, more than twice the 136 million miles of 1985. Then if you add technology of performance to reflect the effects of increased speed, TFI predicts that nearly 500 million miles of 60 mph tire life will be produced by each tire worker in 2000, five times more than in 1980.

All these numbers are interesting. Whether or not they have any utility is debatable. One number I found of real interest was included in a table entitled *Forecast for jobs*. Through the year 2000 there is forecast a decline in tire worker employment while the numbers of tires per worker per year increases significantly. But the real eye catcher is number of tires produced per year. TFI's numbers reach 397 million, a 155 million increase over 1984's totals! If this total bears out we're in for a great ride whether it be at 55, 60 or 74.

Don R. Smith

Editor

RubberWorld

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Business Briefs

lestrom plant near Oslo, Norway for European markets.

Bridgestone Corp. opened a representative office in Beijing, China.

Peabody TecTank, Parsons, KS will fabricate and sell the gravity-flow Phillips In-Tank Blender under license from **Phillips Petroleum**.

Financial statements

ARCO Chemical reported net income of $66 million on revenues of $503 million for the third quarter.

Blasius Industries' operating income for the first quarter of 1988 was $703,000 on sales of $11.9 million.

Carlisle Companies' third quarter earnings were $5.4 million on sales of $141.8 million.

Cooper Tire & Rubber reported third quarter net income of $8.2 million on sales of $176.5 million

Essex Chemical reported third quarter net income of $95,000 on sales of $53.6 million.

BFGoodrich had a net income of $42.4 million for the third quarter on sales of $564 million.

Goodyear reported third quarter income of $170.4 million on sales of $2.5 billion.

M.A. Hanna reported net income of $10 million for the third quarter on revenues of $135.1 million.

NL Industries' third quarter net income was $18.2 million on net sales of $355.6 million.

Lydall, Inc. reported third quarter earnings of $741,000 on sales of $33 million

Parker Hannifin reported a first quarter net income of $21.8 million on sales of $498.5 million.

PPG reported third quarter net earnings of $91.3 million on sales of $1.26 billion.

Rubbermaid reported third quarter net earnings of $24.3 million on sales of $276 million.

The Standard Products Co. reported first quarter net

RMA tire report through July (figures in thousands of units)

Passenger tires	YTD '87	YTD '86	% change
Shipments			
original equipment	31,893	32,602	-2.17
radial	27,022	27,330	-1.13
replacement	84,698	74,438	13.78
radial	75,568	63,819	18.41
export	3,222	2,175	48.14
radial	2,792	1,646	69.62
total	119,813	109,215	9.70
radial	105,382	92,795	13.56
Production	96,729	91,172	6.10
radial	84,439	77,033	9.61
Truck & bus tires			
Shipments			
original equipment	4,658	4,138	12.57
radial	3,238	2,749	17.79
replacement	19,354	16,161	19.76
radial	10,355	7,619	35.91
export	1,109	762	45.54
radial	779	466	67.17
total	25,121	21,061	19.28
radial	14,372	10,834	32.66
Production	20,480	17,956	14.06
radial	11,590	8,657	33.88

RMA rubber report through August (figures expressed in metric tons)

	YTD 1987	YTD 1986	% change
Total new rubber			
New rubber available	2,180,147	2,020,583	7.90
Imports	742,838	693,346	7.14
Exports	330.034	252,228	30.85
Apparent consumption	1,845,131	1,759,886	4.84
Total natural rubber			
Imports	551,684	521,066	5.88
Exports	23,283	25,937	-10.23
Apparent consumption	526,582	504,237	4.43
%total new rubber	28.53	28.65	
Total synthetic rubber			
Production	1,437,309	1,327,237	8.29
Imports	191,154	172,280	10.96
Exports	306,751	226,291	35.56
Apparent consumption	1,318,549	1,255,649	5.01
Total SBR			
Production	559,147	507,762	10.12
Imports	54,455	68,057	-19.99
Exports	111,925	63,405	76.52
Apparent consumption	503,895	515,262	-2.21
Total nitrile			
Production	43,824	40,948	7.02
Imports	10,278	8,107	26.78
Exports	9,044	7,800	15.95
Apparent consumption	43,933	40,979	7.21
Polybutadiene			
Production	240,881	230,244	4.62
Imports	57,743	36,280	59.16
Exports	41,967	14,116	197.30
Apparent consumption	258,652	237,788	8.77
Ethylene-propylene			
Production	167,720	158,120	6.07
Imports	4,014	3,072	30.66
Exports	31,152	31,107	.14
Apparent consumption	135,192	126,129	7.19
Butyl, polychloroprene, polyisoprene, silicone and other synthetic elastomers			
Production	425,736	390,162	9.12
Imports	64,664	56,764	13.92
Exports	112,663	109,863	2.55
Apparent consumption	376,877	335,491	12.34

Business Briefs

U.S. industrial rubber product shipments (millions of dollars)

Item	1977	1986	1991	1995	% Annual growth 86/77	91/86
GNP (bil$)	1991	4206	5850	7675	8.7	6.8
rbr prdts/000$ GNP	1.58	1.35	1.23	1.11	–	–
Industrial rubber prd. shpts.	3142.6	5683.6	7200	8550	6.8	4.8
belts & belting	609.3	784	920	1035	2.8	3.3
hose	709.2	1076.7	1340	1570	4.7	4.5
molded & other mech. prods.	1824.1	3822.9	4940	5945	8.6	5.3
Price Index (1986=100)	70.3	100	113.4	123.6	4.0	2.5
Ind. rubber products (bil 1986$)	4470.3	5683.6	6920	6920	2.7	2.2

source: Freedonia

income of $4.4 million on sales of $102.7 million.

Markets, news

Industrial rubber products shipments are projected to grow 4.8% per year through 1991 to $7.2 billion according to an industry study, *Industrial Rubber Products*, from The Freedonia Group, Cleveland, OH. Virtually all rubber sectors will experience slow growth (below GNP) which will result in real shipment growth of about 2.2% per year. Price increases will be low as a result of continued import pressures. Limited opportunities are anticipated in selected niches such as single ply roofing.

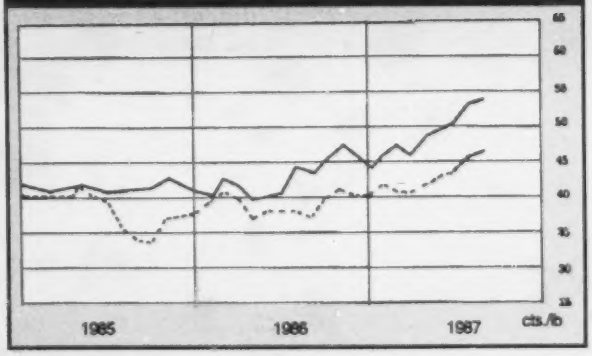
Competition from polyurethane and plastics will affect growth in hose and belting markets. Traditional consumers, agriculture and mining, are expected to recover through 1991 as oil prices increase, the study says. Opportunities are expected for molded rubber products in the oil and gas market and off-highway products, as well as appliance, farm and mining products.

Another study, this one by Eldib Engineering & Research, Berkeley Heights, NJ, predicts that the retail condom market, which is already at $194 million, will be increasing 13-14% each year, bringing the market to $275 million in 1990. This 40% increase from 1987-1990 will create a demand for new materials and represents opportunity for suppliers of natural and synthetic latex, as well as for companies who currently have latex dipping operations.

The U..S. International Trade Commission unanimously determined that there was reasonable indication that U.S. producers of nitrile rubber were injured or threatened with injury by reason of imports of nitrile rubber from Japan. The antidumping petition was filed by Uniroyal on behalf of the domestic nitrile industry. The petition states that Nippon Zeon is selling nitrile rubber in the U.S. at a price significantly below its-fair market value in Japan. As a result of the ITC determination, the Department of Commerce will now investigate the alleged unfair pricing.

The current tight market for butadiene in Europe and the U.S may be only temporary according to Chem Systems, Tarrytown, NY who just published *C_4 Olefins in Europe*. A key part of the analysis is a world trade balance, which indicates a growing surplus of butadiene in Europe as imports by the U.S. drop to zero by about the end of the decade and the U.S develops its own butadiene surplus.

U.S. natural rubber prices 1985-1987



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